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A Tool for Integrating Pervasive Services and Simulating Their Composition

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Abstract. As computation and services are pervading our working and living environments, it is important for researchers and developers to have tools to simulate and visualize possible executions of the services and their compositions. The major challenge for such tools is to integrate highly heterogeneous components and to provide a link with the physical environment. We extend our previous work on the RuG ViSi tool [4], in a number of ways: first, we provide a customizable and interactive middleware based on open standards (UPnP and OSGi) [3]; second, we allow any composition engine to guide the simulation and visualization (not only predefined compositions using BPEL) [3]; third, the interaction with simulated or physical devices is modular and bidirectional, i.e., a device can change the state of the simulation. In the demo, we use an AI planner to guide the simulation, a number of simulated UPnP devices, a real device running Java, and a two room apartment. The related video is available at http://www.youtube.com/watch?v=2w_UIwRqtBY.

Domotics is concerned with the automation of the home in order to improve the safety and comfort of its inhabitants, by having numerous loosely-coupled and heterogeneous devices working together. The EU Smart Homes for All (SM4All) project provides a Service Oriented Computing approach to have the smart home respond to user needs by performing a set of actions and being aware of the home context. The objective is to realise a domotic infrastructure that is highly interactive and adaptive to the needs of different users and environments. The main components of the SM4ALL framework are the building blocks of the implementation presented here and include the pervasive platform, the composition module, and the visualisation and simulation tool. Figure 1 illustrates how these components interact with each other. The pervasive platform is where the devices of the house live. The devices are described following the UPnP (www.upnp.org) protocol, and are wrapped as service components at the OSGi (www.osgi.org) platform. Non-UPnP devices are also supported by deploying a UPnP proxy. In Figure 1 the pervasive platform includes a set of simulated

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devices (door, window and TV) that use the UPnP protocol, as well as a physical Sentilla mote (www.sentilla.com) with a ZigBee interface. Several clients can subscribe to the server built on top of the OSGi framework, and interact with the service components by exchanging SOAP messages, as well as receive notifications about new devices and contextual changes.

The composition module we use in the current demo to drive the simulation and visualization is registered as a client, and is responsible for registering the state of the home, as well as for coordinating the available services. The most important part of the composition component is the planner, which is domain-independent and builds upon constraint satisfaction techniques [2]. A rule engine is responsible for identifying whether certain conditions hold, and accordingly triggering some appropriate pre-defined goals, e.g. to deal with an event of fire. The user can also issue his own goals through the Brain-Computer Interface (BCI) [1] and web interfaces, e.g. a request to watch TV. The computed plan is then passed to an orchestrator that executes it by invoking the corresponding operations at the pervasive layer, which are in turn visualised at the simulated home environment.

The simulation and visualisation platform –the *RuG ViSi tool*– is an extension of our initial work presented last year at the ICSOC Demo session [4]. It is based on Google SketchUp for the 3D rendering. The most notable improvements are: first, we provide a customizable and interactive middleware based on open standards (UPnP and OGSi); second, we allow any composition engine to guide the simulation and visualization third, the interaction with simulated or physical devices is modular and bidirectional. In addition, we now fully comply with the modular SM4ALL architecture.

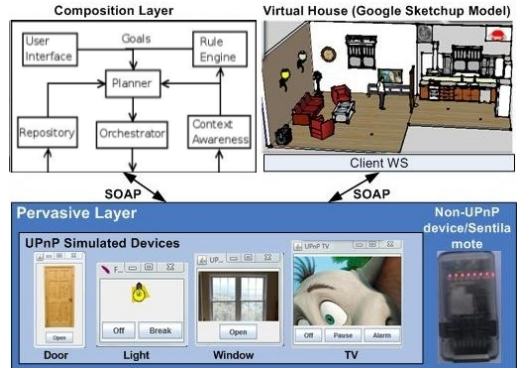


Fig. 1. Architectural Overview

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